

A NEW SPECIES AND SOME NEW COMBINATIONS IN CALYLOPHUS (ONAGRACEAE)

HOWARD F. TOWNER and PETER H. RAVEN

The evolution and breeding systems of the genus *Calylophus* have been the subject of dissertation research by the senior author for the past three years. Information from this work has led to a biosystematic study and a taxonomic revision of the genus, which will be published in the near future. The present paper is intended to validate our new combinations and a new species in advance of their use in the forthcoming *Manual of the Vascular Plants of Texas* by Donovan S. Correll and Marshall C. Johnston. The research on *Calylophus* has been supported by National Institutes of Health graduate research fellowship 2-FO1-GM-32,708-02 to the senior author and by National Science Foundation research grant GB-7949X to the junior author.

Calylophus encompasses two former subgenera of *Oenothera* which were recognized by their peltate or discoid stigmas, and in our treatment will consist of five species. The only monograph concerned with those species has been that of Munz (1929). In it were recognized four species of *Oenothera* subg. *Salpingia* and one of subg. "*Calylophis*." Recent unification of these taxa as the genus *Calylophus* by Raven (1964) created a small, cohesive group of species which showed more affinity to such genera as *Gaura* and *Clarkia* than to other species formerly referred to *Oenothera*. This change was followed by Shinnery in his treatment of the Texas species of *Calylophus* (1964). Shinnery attempted to draw new taxonomic lines between infraspecific groups, and he reduced a number of taxa to synonymy or varietal status. Munz's contribution to the *North American Flora* (1965) retained the traditional generic alignment of the Onagraceae, with *Calylophus* included in *Oenothera*. Most of the forms in the subgenus *Salpingia* were accorded specific rank.

Our investigation has resulted in a view of the *Calylophus hartwegii* group which agrees with Shinnery's treatment in regarding it as an assemblage of intergrading infraspecific taxa. Several minor differences appear between the two discussions. First, we prefer to use the rank subspecies as the only infraspecific taxon, for reasons presented by Raven (1969). The entities within *C. hartwegii* intergrade, but retain their identities over large geographical ranges. They are thus major forms which are best dealt with by according them subspecific status. Secondly, we recognize *C. hartwegii fendleri*, which constitutes a distinctive series of populations distributed over a definite eco geographical range. The third difference, to be fully treated in the forthcoming revision, consists of small changes in the boundaries between taxonomic

entities. According to our study, there is no justification at present for distinguishing between two major groupings within this complex, such as *O. greggii* and *O. hartwegii* in the sense of Munz (1929). Intergradation occurs between nearly any two forms which come into contact. A reticulate pattern of phenetic and crossing relationships is evident, so the only logical approach is to place all of the forms in *C. hartwegii*.

The *Calylophus serrulatus* group, like the *C. hartwegii* complex, has never been well understood, either in a biological or taxonomic sense. We have discovered that this assemblage includes one outcrossing self-incompatible species, *C. drummondianus*, and two species which are self-pollinating complex structural heterozygotes. The interpretation of this group was particularly difficult in the past, since the three species often exhibit parallel patterns of geographical variation. It is not surprising, therefore, that this situation has led to widely differing taxonomic treatments.

CALYLOPHUS Spach, Hist. Veg. Phan. 4: 349. 1835. *Meriolix* Raf., Amer. Monthly Mag. & Crit. Rev. 4: 192. 1819; nomen nudum. Raf., J. Phys. Chim. Hist. Nat. Arts 89: 259. 1819; nomen nudum. Walp., Repert. 2: 79. 1843. *Calylophus* Spach, Hist. Veg. Phan. 4: 349. 1835. *Calylophis* Spach, Nouv. Ann. Mus. Hist. Nat. III. 4: 337. 1835. *Oenothera* subg. *Calylophis* (Spach) T. & G., Fl. North Amer. 1: 501. 1840. *Oenothera* subg. *Salpingia* T. & G., Fl. North Amer. 1: 501. 1840. Type: *O. lavandulaefolia* T. & G. = *Calylophus hartwegii* ssp. *lavandulifolius* (T. & G.) Towner & Raven. *Salpingia* (T. & G.) Raimann, in Engler & Prantl, Naturl. Pflanzenfam. III. 7: 217. 1893; non Mart. 1828. *Galpinsia* Britt., Mem. Torrey Bot. Club 5: 236. 1894.

Perennial herbs, sometimes with slightly woody lower stems and base. Flowers actinomorphic, borne in axils of upper leaves, opening near sunset, in mid-afternoon, or near sunrise; hypanthial tube well-developed; petals yellow, fading pink or orange in some species. Stigma peltate to discoid or globose-peltate, sometimes shallowly 4-lobed. Gametic chromosome numbers, $n = 7, 14$. Three of the five species are self-incompatible; two are self-compatible.

Type. *Calylophus nuttallii* Spach. *C. serrulatus* (Nutt.) Raven. Five species will be recognized in this paper and in the forthcoming revision. They occur throughout the Great Plains from southern Canada to Texas, and from the Great Basin and Southwest to north-central Mexico. The genus is vaguely divisible into groups corresponding to *Oenothera* subg. *Calylophus* and *Salpingia*, but the characters used to distinguish them, namely sepal midrib height and hypanthial tube length, vary within each complex. This separation may be used with caution in keys, however no sectional division has been made because of the variability and the small size of the genus.

CALYLOPHUS HARTWEGII (Benth.) Raven, *Brittonia* 16: 286. 1964.
Oenothera hartwegii Benth., Pl. Hartw. 5. 1839

CALYLOPHUS HARTWEGII ssp. **lavandulifolius** (T. & G.) Towner & Raven, comb. nov. *Oenothera lavandulaefolia* T. & G., Fl. North Amer. 1: 501. 1840.

CALYLOPHUS HARTWEGII ssp. **fendleri** (Gray) Towner & Raven, comb. nov. *Oenothera fendleri* Gray, Mem. Amer. Acad. Arts II. 4: 45. 1849.

CALYLOPHUS HARTWEGII ssp. **pubescens** (Gray) Towner & Raven, comb. nov. *Oenothera greggii* var. *pubescens* Gray, Pl. Wright. 1: 72. 1852.

CALYLOPHUS HARTWEGII ssp. **filifolius** (Eastw.) Towner & Raven, comb. nov. *Oenothera tubicula* var. *filifolia* Eastw., Proc. Calif. Acad. Sci. III. 1: 72. 1897.

CALYLOPHUS HARTWEGII ssp. **toumeyii** (Small) Towner & Raven, comb. nov. *Galpinsia toumeyii* Small, Bull. Torrey Bot. Club 25: 317. 1898.

CALYLOPHUS HARTWEGII ssp. **maccartii** (Shinners) Towner & Raven, comb. nov. *Calylophus hartwegii* var. *maccartii* Shinners, Sida 1: 343. 1964.

CALYLOPHUS TUBICULA (Gray) Raven, *Brittonia* 16: 286. 1964.
Oenothera tubicula Gray, Pl. Wright. 1: 71. 1852.

CALYLOPHUS SERRULATUS (Nutt.) Raven, *Brittonia* 16: 286. 1964 (published in error as *Calylophus serrulata*, since the gender of *Calylophus* is masculine). *Oenothera serrulata* Nutt., Gen. North Amer. Pl. 1: 246. 1818.

CALYLOPHUS DRUMMONDIANUS Spach, Ann. Sci. Nat. Bot. II. 4: 272. 1835 (published as *Calylophis drummondiana*).

CALYLOPHUS DRUMMONDIANUS ssp. **berlandieri** (Spach) Towner & Raven, comb. nov. *Calylophis berlandieri* Spach, Ann. Sci. Nat. Bot. II. 4: 273. 1835.

Calylophus australis Towner & Raven, sp. nov. A *Calylopho serrulato* similis, pubescentia sparsa trichomatibus crassis saepe incurvatis differt; foliis oblanceolatis, interdum linearibus, longissimis 15–35 mm longis, 1–4 mm latis, plerumque grosse serratis; petalibus 7–13 mm longis; arenosum “Texas Gulf Coast” secus. Herba suberecta vel effusa, 1.5–5 dm. alta, simplex vel basi ramosa. Folia longissima pubescentia sparsa appressa sursum deorsumque, linearia vel oblanceolata, sub-

integra vel grosse serrata, subsessilia, sursum deminuta solum exigue. Tubus hypanthii infundibuliformis, basi tubularis, in sectione transversali subquadratus, costibus 4 prominentibus, 6–12 mm longus, apice 4–9 mm diametro, extus subglaber vel sparse pubescens, intus glaber. Sepala ovata, 4–7 mm longa, exigue vel manifeste costata, apicibus subulatis 0.2–1 mm longis. Petala obovata vel obcordata, saepe vadose incisurata, 7–13 mm longa lataque. Stamina biseriata, filamenta epipetalorum 3–6 mm longa, episepalorum ca. 2–4 mm longa; anthera 2–4 mm longa. Stylus 8–15 mm longus, glaber; stigma discoideum, subquadratum, infra subsulcatum, 1–2 diametro, antheris circumdatum. Capsula cylindrica, sessilis, 12–28 mm longa, 1–2 mm crassa, sparse pubescens. Semina brunnea, 0.7–1 mm longa, ovoidea, acute angulata, extremitate unustantum lateribusque complanata, subgranulosa. Autogama. Numerus chromosomaticus gameticus, $n = 7$.

Type. Texas. Cameron Co.: On Texas route 4, 2.8 miles west of end of road at Boca Chica. Large population along low ridge at roadside, ca. 100 yards from tidal sandflat. *Towner 187*, May 29, 1969 (DS 612434-holotype, RSA, TEX, US). Chromosome determination of holotype: $n = 7$ (ring of 14 at meiotic metaphase I).

Distribution. Occasional on sand and shell-hash soils along Texas Gulf Coast, on shores of bays, and on offshore islands. Occurs from Brazos and Galveston counties south to the Mexican border. Expected from northern coast of Tamaulipas. Seventy-four specimens from the the following herbaria have been examined during the course of this study: ARIZ, DS, F, GH, LL, MO, NEB, NY, OKL, OKLA, PH, POM, RSA, SMU, TEX, US, WTU.

Vouchers for chromosome counts. Texas. Aransas Co.: 1.3 miles west of Copano Village, *Towner 182* (DS), 1 plant with probable ring of 14 and 1 plant with 1_{II} and probable ring of 12; 5.8 miles southeast of Aransas Pass on State Highway 361, *Raven & Gregory 19393* (DS), 2 plants with ring of 14 grown from seed at Stanford. Cameron Co.: Texas Route 4, 2.5 miles west of end of road at Boca Chica, *Towner 188* (DS), 1 plant with probable ring of 14 and 1 plant with 1_{II} and probable ring of 12. Jackson Co.: Texas Highway 35, 11.2 miles west of Palacios, *Towner 175* (DS), one plant with 1_{II} , ring of 12, and 1_{II} of diminutive chromosomes. Matagorda Co.: 6.5 miles south of Matagorda on road to coast (Farm Road 2031), *Towner 174* (DS), probable ring of 14. San Patricio Co.: 3.5 miles south of Ingleside on Farm Road 1069, ca. $\frac{1}{2}$ mile from Corpus Christi Bay, *Towner 184* (DS), 2 plants with ring of 14.

The new species, like *Calylophus serrulatus*, differs from *C. drummondianus* in its smaller flowers, self-compatibility, and pollen sterility of 30–60%. The small-flowered species are complex structural heterozygotes, their 14 chromosomes normally forming a ring at diakinesis. Some individuals of both species exhibit one pair and a ring of 12. Both

C. australis and *C. serrulatus* seem to be derived from *C. drummondianus*, which has normal chromosome pairing during meiosis. They also seem to have arisen independently from *C. drummondianus*, as suggested by their phenetic affinities and geographical ranges.

Calylophus drummondianus ssp. *berlandieri* and *C. australis* are very similar vegetatively, and their flower sizes occasionally overlap. Because of this and their occasional sympatry, some herbarium material is difficult to identify. Unopened buds may be removed from the sheets, and the pollen can be stained and checked for fertility. This method can be used to assign most doubtful specimens to one of the two taxa. Berlandier's type, although from typical *C. australis* habitat, proved to have highly fertile pollen. Thus it was assigned to *C. drummondianus*, and a new type was required for the structural heterozygote.

Calylophus australis differs from *C. serrulatus* primarily in the short, thick, sparse stem hairs, versus the fine, appressed, dense canescence of the latter species. There are some plants from eastern Texas which have the pubescence of *C. australis*, but have longer leaves and taller stature. *Calylophus australis* has short, usually coarsely serrate leaves, and is sub-erect. *Calylophus serrulatus* has a wide range of leaf dimensions, but the margins are coarsely serrate only in specimens whose leaf size exceeds that of *C. australis*. *Calylophus serrulatus* occurs throughout the Great Plains, occupying a wide range of soil types, while *C. australis* is endemic to sandy soil, generally along the southern coast of Texas. The two species seem to come into contact only in inland eastern Texas. In Brazos and Madison counties, the populations are *australis*-like, and in neighboring counties to the north the plants combine the pubescence of *C. australis* and the large leaves of eastern *C. serrulatus*. These intermediate populations seem to be isolated slightly from the main distributions of the two species. They may be occupying an area of former hybridization or they may be further autogamous derivatives of *C. drummondianus*.

Department of Biological Sciences, Stanford University

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